Sample Calculations for Restricted Distance (Pneumatic Pressure Test) NASA Glenn Research Center

The first step is to determine the volume of the system.

Assuming a 100 cc sample cylinder:

$$V_{cyl} = 100 \cdot cm^3$$
 or $V_{cyl} = 3.531 \cdot 10^{-3} \cdot ft^3$

All tubing in the system is 0.25 inch O.D. with an 0.035 inch wall. The cross-sectional area of the tube is:

$$A_{tube} = \frac{\pi \cdot (0.25 \text{ in} - 2 \cdot 0.035 \text{ in})^2}{4} \qquad A_{tube} = 0.25 \cdot \text{in}^2 \text{ or } A_{tube} = 1.767 \cdot 10^{-4} \cdot \text{ft}^2$$

Assuming, conservatively, twenty feet of tubing in the system, the tubing would be:

$$V_{\text{tube}} = 20 \cdot \text{ft} \cdot A_{\text{tube}}$$
 $V_{\text{tube}} = 3.534 \cdot 10^{-3} \cdot \text{ft}^3$

The total system volume would be:

$$V_{total} = V_{tube} + V_{cyl}$$
 $V_{total} = 7.066 \cdot 10^{-3} \cdot ft^3$

The maximum test pressure of the system is 1.25 times the Maximum Allowable Working Pressure (MAWP) of the system. Assuming an MAWP of 240 lbs/in², the maximum test pressure would be:

$$P_{\text{test}} = 1.25 \cdot 240 \, \frac{\text{lb}}{\text{in}^2} \qquad = 300 \, \frac{\text{lb}}{\text{in}^2}$$

According to the chart for restricted distance based on 1000 cubic feet, the restricted distance is:

$$D_{1000} = 225 \cdot ft$$

The correction formula for the actual system volume is:

$$D_{\text{system}} = \frac{D_{1000} \cdot \sqrt[3]{V_{\text{total}}}}{10 \cdot \text{ft}} \qquad D_{\text{system}} = 4.3 \cdot \text{ft}$$

Sample Calculation of Restricted Distance for Pneumatic Testing

Assume that a liquid hydrogen tank of the following specifications is to be pneumatically pressure tested:

1. Tank volume = 300 cubic feet

2. Maximum allowable working pressure = 2000 psia

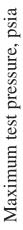
3. Pneumatic test pressure $= 1.25 \cdot 2000 \text{ psia} = 2500 \text{ psia}$

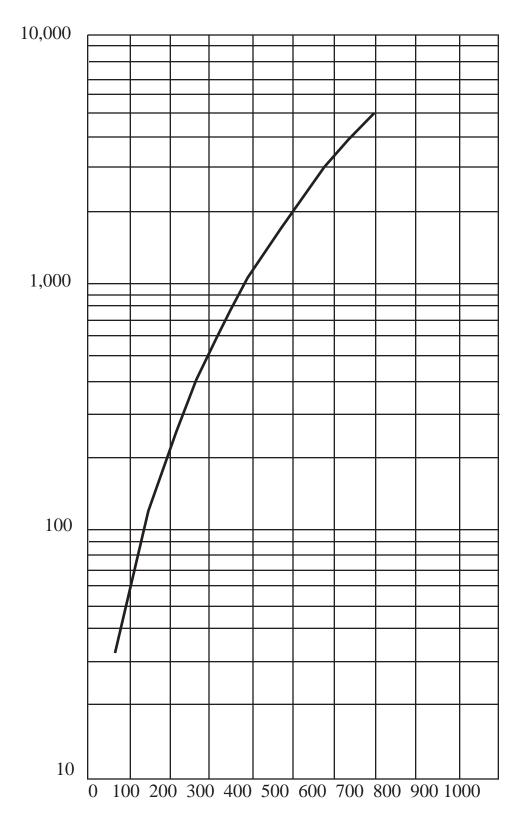
From the figure on the following page, it is determined D = 550 feet for a test pressure of 2500 psia.

Applying the formula: $= \underline{D \cdot \sqrt[3]{\text{Volume of actual system}}}$

Restricted testing distance in feet: $= \frac{550 \cdot \sqrt[3]{300}}{10}$

Restricted testing distance: =370 feet





D - Restricted testing distance for 1000 ft³ system (in feet)